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## INFORMATION REPORT

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COMPONENTS AND CHARACTERISTICS OF MOTORS PRODUCED AT ZAVOD 393.Special Electric Motors

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25X1X 1. From about the middle of 1947 [REDACTED] in January 1952, [REDACTED] experimental department [REDACTED] was engaged in the production of special electric motors in two series. The larger of the two, the MUKS, was produced in lots of approximately 30 per month during the entire period [REDACTED]. The smaller motor, the MU 010, had an average production quota of about 200 units per year. An interesting aspect of the production of these motors was the fact that only small lots were requested at a time, the production order was filled, and a suspension period would occur until another request was received. 25X1X

Electric Motor MU 010

2. This motor operated on 24-volt direct current. Without load, the motor produced 3500 to 3700 revolutions per minute, and, under required output, operated at 3000 rpms. I believe specifications required this motor to maintain a 3000 rpm constancy since the satisfactory acceptance test consisted of ten (10) centimeter-grams at 3000 rpm. If this figure was not achieved, the motor was rejected. Physically the motor was a 30 x 60 millimeter cylinder without a mounting base or mounting fixtures.

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Description of Assembly Groups and Individual Parts

3. The motor consisted of two main groups and several individual parts. The first main group was the armature group, consisting of the axle shaft, the armature spider package with 24 plates, and the commutator (Achse, Ankerpaket mit 24 Scheiben, und Kollektor). The commutator was composed of a copper ring divided into 24 sections. The copper ring was shaped on a lathe jig (Drehvorrichtung [see page 12]). The individual sections were then insulated with mica (Glimmer) and the collector ring was placed on the axle shaft with compressed bakelite by means of a pressing die. The bakelite powder and the collector ring were compressed on the axle-shaft under very high pressure and temperature in the pressing die.
4. The 24 dynamo sheet-metal discs (Dynamoblech) [see page 12] of the armature spider package were slipped onto the motor axleshaft with the stamped-out notches lying parallel to the axle. The discs were painted with insulating lacquer and pressed together in a press jig (Pressvorrichtung). After the desired compression had been achieved, the entire unit with the affixed press jig (Pressvorrichtung) was placed in a drying oven from three to four hours at 100 to 120° C. After removal from the oven the rotor pack was wound with 0.07-0.08 millimeter copper, lacquer-insulated wire. The windings were made in the electro laboratory, which was not in our department, but I would estimate there were 50-60 windings for each of the twelve fields. After the winding was completed, the ball bearing races were fitted on the axleshaft.
5. The other main grouping in this motor was the stator group, consisting of three parts. The parts were the aluminum housing [see page 13], two curved sections [see pages 12-13], and the permanent magnet [see page 12]. The curved steel sections were screwed securely to the aluminum part [see pages 12-13]. The permanent magnet was cast of a special magnetic alloy. [redacted] the Japanese first used this type of magnetic alloy casting.) The permanent magnet was very hard and had to be trimmed and calibrated (bearbeitet) on a grinder. One end of the stator had a cylindrical recess, which served as the precise receptacle for the permanent magnet. An orientating pin positioned the magnet in proper relation to the steel sections.
6. The motor cap (Abschlusskappe) served as the retainer for the carbon brushes [see page 12]. The bakelite cap was pressed in another department and received the finishing work in our department. The finishing consisted of cutting bearing race recesses, borings for two contact screws, and insertion of two threaded brass bushings which held the carbon brushes and tension spring in proper adjustment by means of an adjusting cap screw [see page 12].
7. The motor housing comprised another assembly part. It was an aluminum cylindrical hollow body with the housing and containing the other bearing race recess [see page 13]. The bearing fittings for both the bakelite and the aluminum sections had to meet very fine 0.01 millimeter tolerances.

Motor Assembly

8. The MU Q10 required more experience and care in assembly than the MUKS, or larger motor. Special attention had to be given to the ball bearing fittings to avoid occurrence of possible high spots and meet the specified tolerances. Seating of the bearing races in the motor housing had

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to be accomplished with minimum pressure, so that your thumb could squeeze the bearing into its recess. Unless the bearings were fitted exactly to the aforementioned specifications, strong deformations would occur during the cold temperature tests. If sharp deformations occurred, the required motor power was not achieved.

9. Additionally, the spring pressure of the carbon brushes had to be gauged for identical tension. The brushes and the springs were copper plated in a galvanic bath prior to the tension gauging. We used an improvised tension tester consisting of a small cylindrical fixture, which held the brush and the spring, and a five-gram pin bolt graduated for tolerance limits. The pin bolt was set on top of the spring and brush unit in the test cylinder. The proper spring tension had to exist or the motor would not achieve its required rpm speed.
10. During assembly of the motor the following steps were taken. One bearing was seated in the motor housing, the other placed in the bakelite section. After that the permanent magnet was inserted in its recess in the stator body. The assembled stator was coupled to the housing by means of two screws. Then the rotor was shoved into the stator with the bare axle shaft passing through the bearing. Next the pressed bakelite part with the seated bearing was run onto the axle at the commutator end of the shaft. When the above parts had been assembled, the axle shaft was tried for play tolerance of about 0.03 millimeters. After the shaft was checked and adjusted, the bakelite section was fastened to the motor housing with two screws. Last of all the carbon brushes and springs were inserted, tested for spring tension, and capped with the screw caps.
11.  this small motor had been designed and built to operate at the extreme limits of its capacity. If all the critical points of construction did not accurately meet specification, the motor did not achieve satisfactory performance capacity.

#### SPECIAL ELECTRIC MOTOR WORKS [See pages 6-21]

12. The characteristics of these motors were:
  - a. The motor was driven by 220-volt direct current.
  - b. Without axle load the motor achieved 18,000 to 20,000 revolutions per minute speeds. (I have no knowledge of rpm's under load conditions). My estimate is that the motor has  $\frac{1}{4}$ -3/4 hp.
  - c. The motor was 150 millimeters or 150 millimeters in size, cylindrical in shape, without a mounting base or mount fixtures.

#### Description of Assembly Groups and Individual Parts

13. The groups were as follows:
  - a. Rotor Group. This group was composed of the axle shaft, the commutator, the armature pack and armature winding, two ball bearings, and the coupling.
  - b. Stator Group. This group consisted of the motor housing with the stator packing and the stator winding.

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- c. Individual Parts. Additional individual parts of the motor were the right and the left motor cap, the brush retainers, two carbon brushes with pressure springs and cap screws, and two threaded bolts which held the motor together.

Description of Motor Parts

14. The axle shaft is 160 millimeters long and 13 millimeters in diameter. It is made of ground steel. The armature pack consists of sixty discs (sheet steel: Dynamoblech). The individual discs were insulated with lacquer and then pressed together in a clamping fixture (Pressvorrichtung) until the sixty discs occupied a 42 millimeter span. The axle shaft was then inserted through this armature pack and the notches of the pack were set at a 15 degree angle to the shaft axis [see page 9].  
The entire unit (axle shaft, armature pack with clamping fixture) was placed in a drying oven for three to four hours at 100 to 120 degrees Centigrade. Upon completion of this process, the armature pack was wound with cotton-insulated 0.8 copper wire, about 30 windings for each of the 16 fields.
15. The commutator was composed of a collector ring divided into 32 sections. By means of a jig (Vorrichtung) it was formed into a dove-tail profile [see page 9]. After the individual ring sections had been insulated with mica plates (Glimmerscheiben), the center was fitted with an insulating cylinder of mica [see page 9]. Inside of the mica cylinder was fitted a steel cylinder [see page 9]. The collector ring, the mica cylinder and the steel cylinder were pressed together in a slightly conical jig (Vorrichtung). The protruding edge of the steel cylinder, emerging as the result of pressure on the opposite end, was then flanged over the steel ring [see page 9] to lock the group into a unit. After an insulation test the commutator was ready for mounting on the axle shaft. The commutator was pressed onto the shaft and positioned at the proper distance from the armature.
16. The stator body was composed of sixty sheet metal discs. Each of the individual discs was insulated with lacquer and the total number was compressed to a 42 millimeter span with a clamping device. The discs were then riveted together through the four provided holes [see page 11]. The coil wire was then wound on the stator pack and the unit was spot welded into the motor housing. The housing and the stator pack with the coils was dipped into an insulating lacquer bath. The unit was then placed in a drying oven for three to four hours at 100 to 120 degrees Centigrade.
17. The left motor cap [see page 10] was made of aluminum casting. The center of the cap contained a threaded aluminum insert which held the bearing race. Tolerance on this part was about 0.02 millimeter maximum. A boring was made through the cast aluminum rib located at the cap's diameter, and from each end a brass bushing, insulated with cardboard, was inserted. Both brass bushings had hollow rectangular cores which received the carbon brushes and brush springs. The carbon brushes were small rectangular bodies made of fine graphite carbon with a curved contact surface radius corresponding to the radius of the commutator.
18. The other motor cap was also made of cast aluminum. The circular casting contained a partial boring to hold the bearing race and a smaller completed boring for the axle shaft.

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19. The assembly of this motor presented no problems. Normally all parts met gauge and tolerance specifications without difficulty. For the first assembling step, the armature was inserted in the stator. Secondly, the bearing races were seated in the motor caps and the caps were slipped over the axle shaft and fitted to the motor housing. Then the armature was checked for free movement and the axle shaft was checked for axial play. Tolerance for axle play was 0.2 millimeters. The axle shaft coupling [see page 8], previously bored and fitted, was then placed on the shaft and fastened with a pin through the diameter. The motor caps were drawn firmly against the cylindrical housing with two threaded connecting bolts. After the brushes had been copper plated and the contact wire had been soldered onto them, the brushes were inserted in the brass retaining bushings, tension springs were placed on top, and caps screwed into the bushings [see page 8].

#### QUALITY OF COMPONENTS USED IN ELECTRIC MOTOR PRODUCTION AT ZAVOD 393

20. The pole pieces of the special permanent magnet in the small motor, MU 010, were made of steel. The magnet (made of an alloy and mentioned earlier in this report) was of excellent quality and appeared to have very strong fields of magnetization. I personally do not know of any other type of material which would have been better for this particular use.

#### Copper

21. The copper wire for the motor windings was wound on wooden spools. The fine wire (0.07 or 0.08 mm.) used in the motor MU 010 consisted of rolls about 60 millimeters wide and 35 millimeters in diameter. The wooden spool itself had a diameter of perhaps 15 to 20 millimeters. The spools of 0.8 millimeter copper wire used in the MUKS motor were about 100 millimeters in diameter and about 120 millimeters wide. The spool diameter was about 50 mm. in diameter. I would estimate there were about 800 meters of wire on each of these large rolls. All writing on the spools was in Russian and consisted only of "Wire, 0.8 mm." etc. The wire was pre-insulated (either fabric or lacquer) and ready for winding.

#### Aluminum

22. The aluminum housing for the small motor was first made in our own department, but was later prepared in one of the lathe shops in another part of Zavod 393. The housings were turned out on lathes from solid aluminum rods with diameters of approximately 30, 31, or 32 millimeters. The 25X1X aluminum rods were 2 or 3 meters long

aluminum was of good quality. After the cylinder housing had been made, it was oxidized black in an electrolytic bath.

#### Ball Bearings

23. Two sizes of ball bearings were used in the assembly of the two motors. During the first year of motor production ending late in 1948, the specifications for the axle shaft diameter were set at 3.17 millimeters. This fitted the bearings which we were using at that time. The peculiar deviation from standard millimeter dimensions given in units of ten aroused our interest. Calculating proved that the 3.17 shaft fitted very well into a 1/8 inch inside diameter American ball bearing which has a 3/8 inch outside diameter. This outside diameter corresponded to the 9.5 millimeter dimension specified for the outside diameter.

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24. After 1948 the axle diameter specification for the small motor was changed to three millimeters and the outside bearing diameter was changed to ten millimeters. At this same time the quality of the bearings used depreciated considerably. This combination of facts convinced us we had been using American bearings to this point. The Soviet bearings, which I am certain were used after 1948, had no markings on them [redacted] 25X1X
25. The larger motor, the MUKS, used Soviet bearings from the beginning of its production. These bearings were of sufficient quality to perform their function without difficulty. The only marking [redacted] 25X1X bearings for this motor was a three letter symbol "C M T" stamped in the race (in German or English the letters are "S M T").
26. I do not know where the bearings were made (all our supplies were brought to us from the central supply room by a Soviet worker who was always uncommunicative), but our supply was adequate for our needs. After we stopped using American bearings (my assumption, anyway), we began to receive bearings which occasionally contained flaws. These flaws usually consisted of undersizes or oversizes in the rings. If the flaw was serious or rendered the piece unworkable we were told to cast the bearing aside and select only those which were suitable.

#### Lubricating Oil

27. The motors were lubricated with a special oil which was acid-free and unaffected by cold temperatures. The oil was golden yellow in color and very thin. Although the oil did not appear to be available in great quantities, and was issued in small flasks, which were never full, the men who used it at the required stage of motor assembly always had sufficient amounts available.

#### Personnel Engaged in Motor Production

28. Approximately 8-10 men were employed in producing these two motors. Actually, after the parts manufacture was finished on a month's order, only a few men remained on the job assembling the motors.

#### Other Soviet Sources of Supply for the Motors

29. I never heard of these motors or similar motors being produced elsewhere in the USSR. Both motors were built from Soviet drawings and designs. The smaller motor did not function at first, and the German workers made many changes before the unit really worked. The greatest problems occurred in the windings of the small motor, the insulation baths and the resultant breakdown of the lacquer insulation, proper arrangement of the commutator in the bakelite form, and the experiments with the proper lubricating oils.
30. I do not believe these motors were copies of American or German types, especially in the case of the MU OLO. I have never seen a German or American model of this type. Furthermore, if the MU OLO had been a copy of another motor, I do not think we would have had so many initial construction and assembly problems. [The source has never heard either of these motors referred to as "rasende Wallnuss" (racing walnut), and does not know under what ministry they were produced.]

#### Screw Manufacture at Zavod 393

31. It was my experience that the Soviets do not use the proper materials for metal screws — the screws I used were generally too hard and brittle to be

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completely satisfactory. There were some general weaknesses in Soviet screw production; foremost of which was the thread diameter. Screws in sizes from 2 to 5 millimeter diameters were usually undersize in actual measurement. Very often the threading of the screw has a defect or a flaw like an unclear thread. The angle of the screw head with the screw stem was often not a clean 90 degrees, a situation which caused difficulty when delicate work was required. The rough condition of the screw and the failure to cut the head and stem at the full 90 degree angle was the result of possibly two things. First, the automatic screw machines are in poor condition and the cutting steel in the cutting devices is dull; secondly (and worst of all), the materials used in screw manufacture are much too hard and brittle, consisting mostly of hard screw steel or brass.

32. Precision screws used in precision work had to be cleaned individually by us before being used. The screw head groove had to be smoothed off, and the metal shreds cleaned off one end of the screw (the result of a dull head grooving saw). I was told

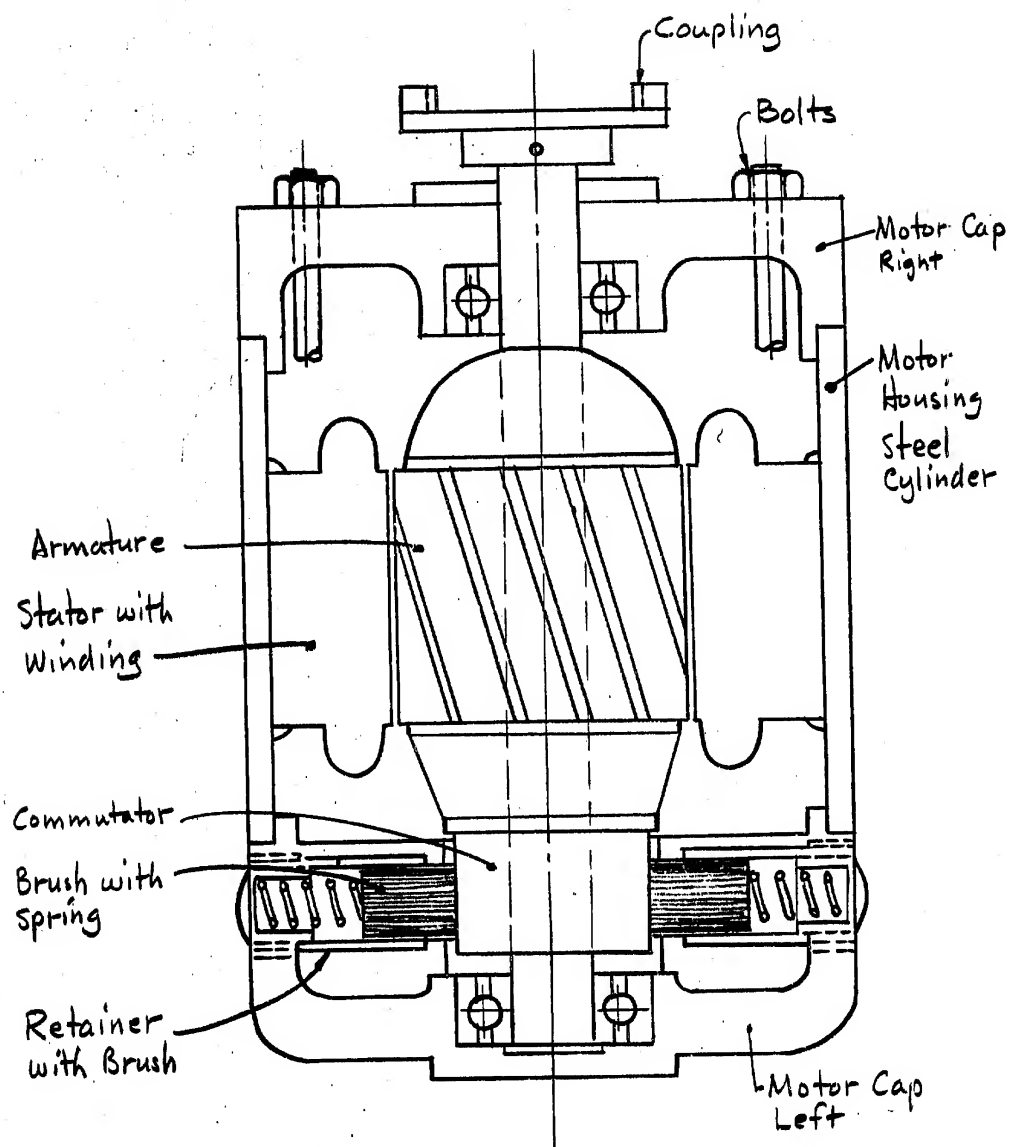
that all screws which are produced in Zavod 393 for our plant still have the screw head grooved one at a time by women, using individual grooving saw jigs instead of using the groove saw jig on the automatic screw machine. The latter case apparently is due to a lack of saws to fit the jigs on the automatic machines. The result is that the head groove appears anywhere and everywhere but in the center of the screw head. This becomes a serious problem in cases where headless screws and threaded pins are used. Because of the hardness and brittle quality of the screw, the weak side of the groove often breaks off, leaving the mechanic or assembler with the difficult task of removing the damaged pin. This becomes an irritating and time consuming task at times. The above mentioned points are not severe or serious shortcomings, but they suffice to make the worker's job of mounting, assembly, or fabrication all the more difficult and annoying, plus weakening the total product.

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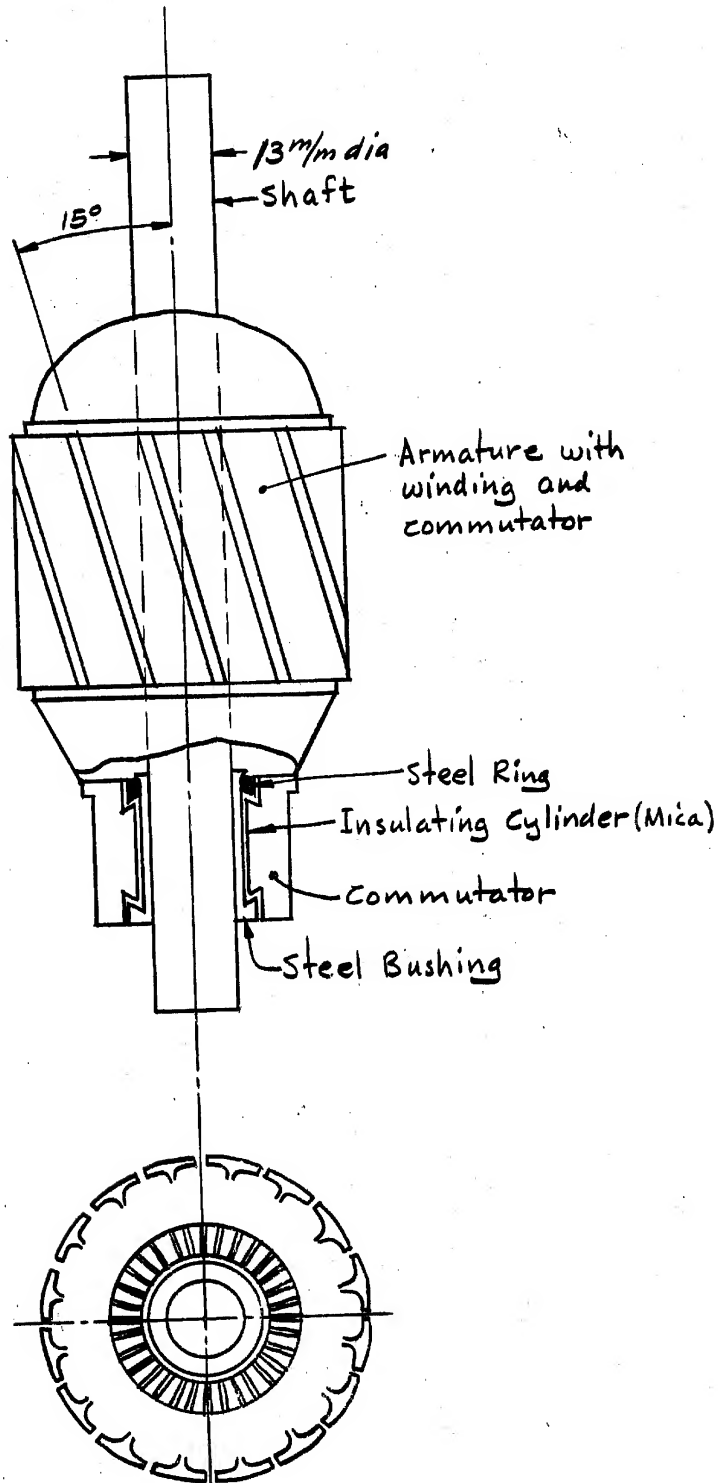
MOTOR "MUKS"

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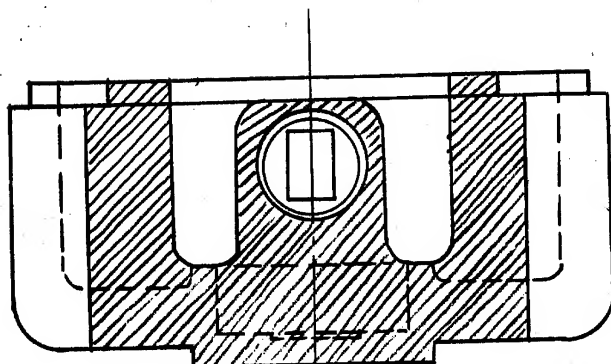
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Design details of MOTOR "MUKS"

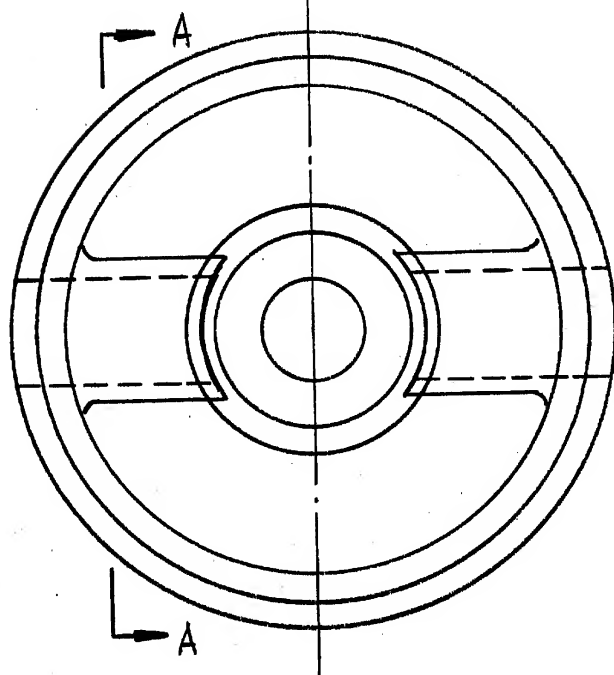
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SECTION A-A



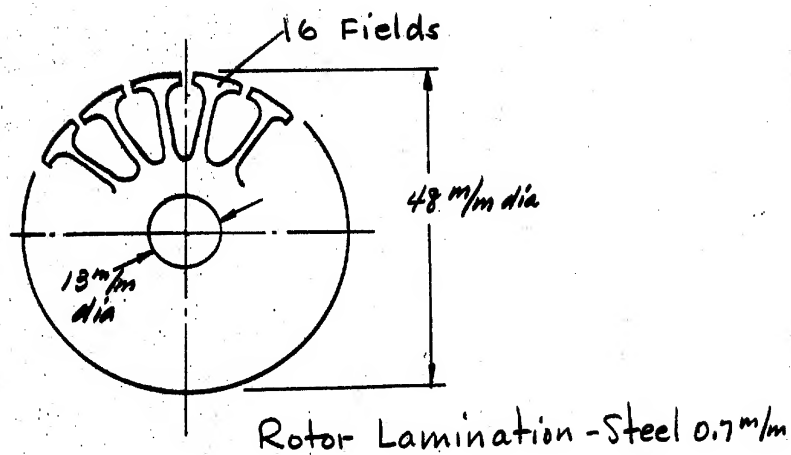
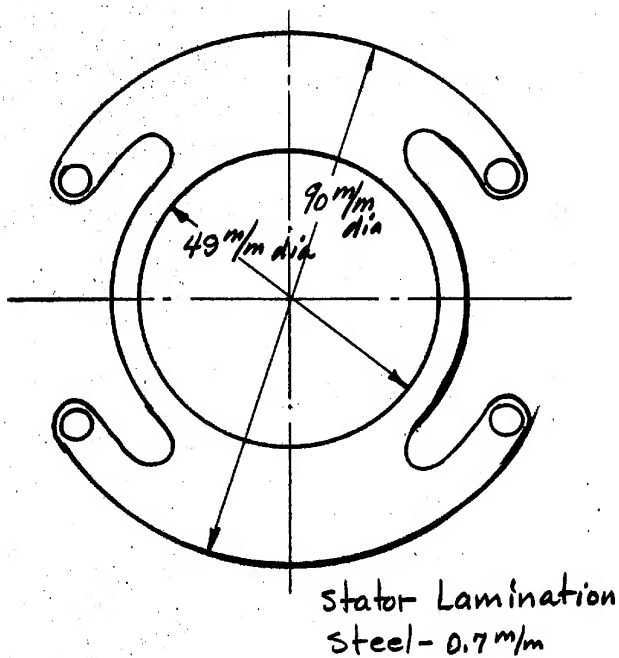
Detail of Motor Cap - Left - "MUKS" MOTOR

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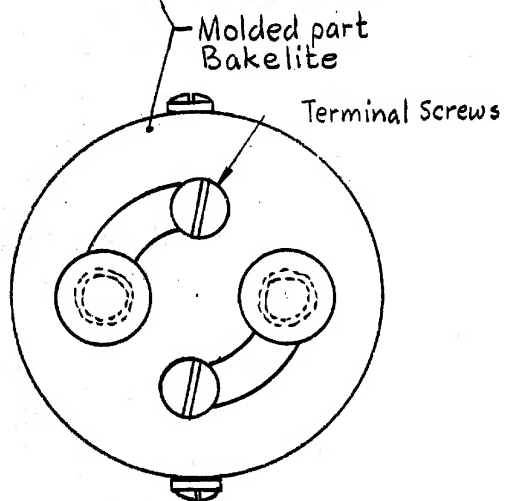
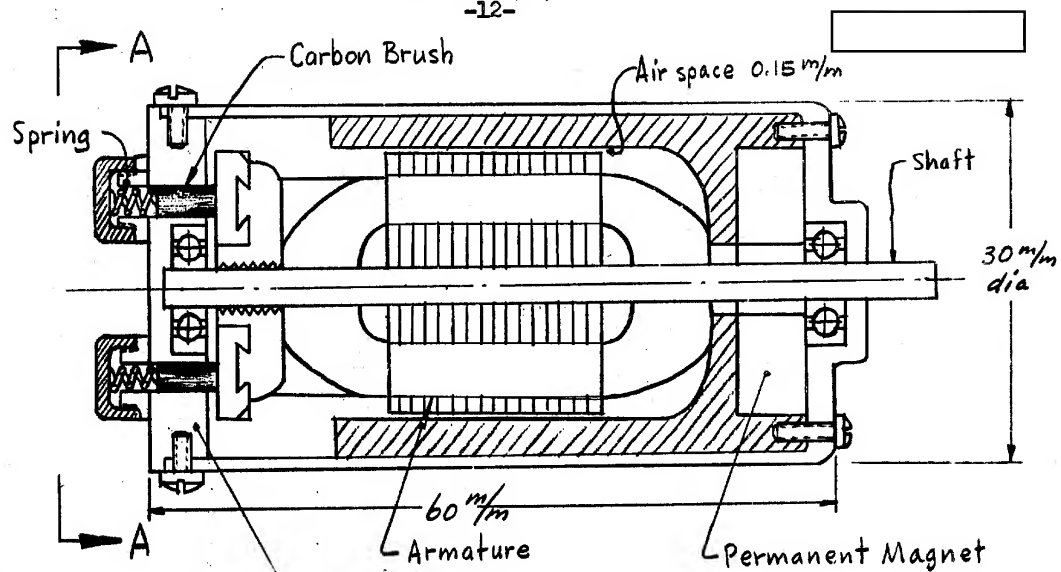


Design details of the "MURS" Motor

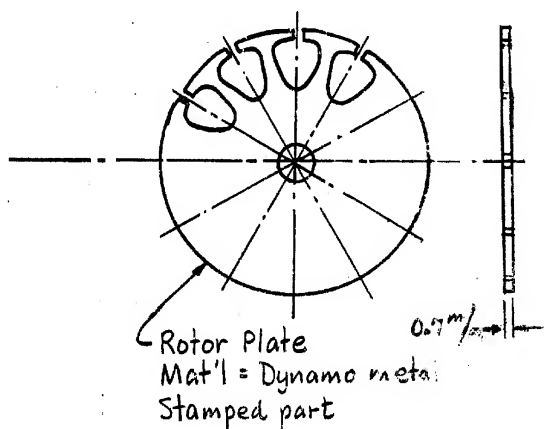
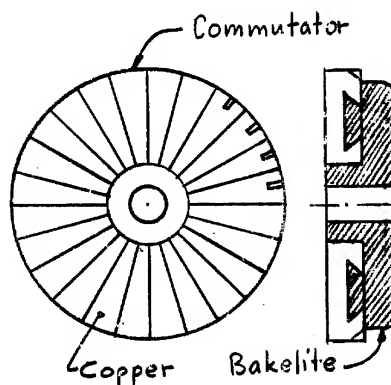
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View A-A

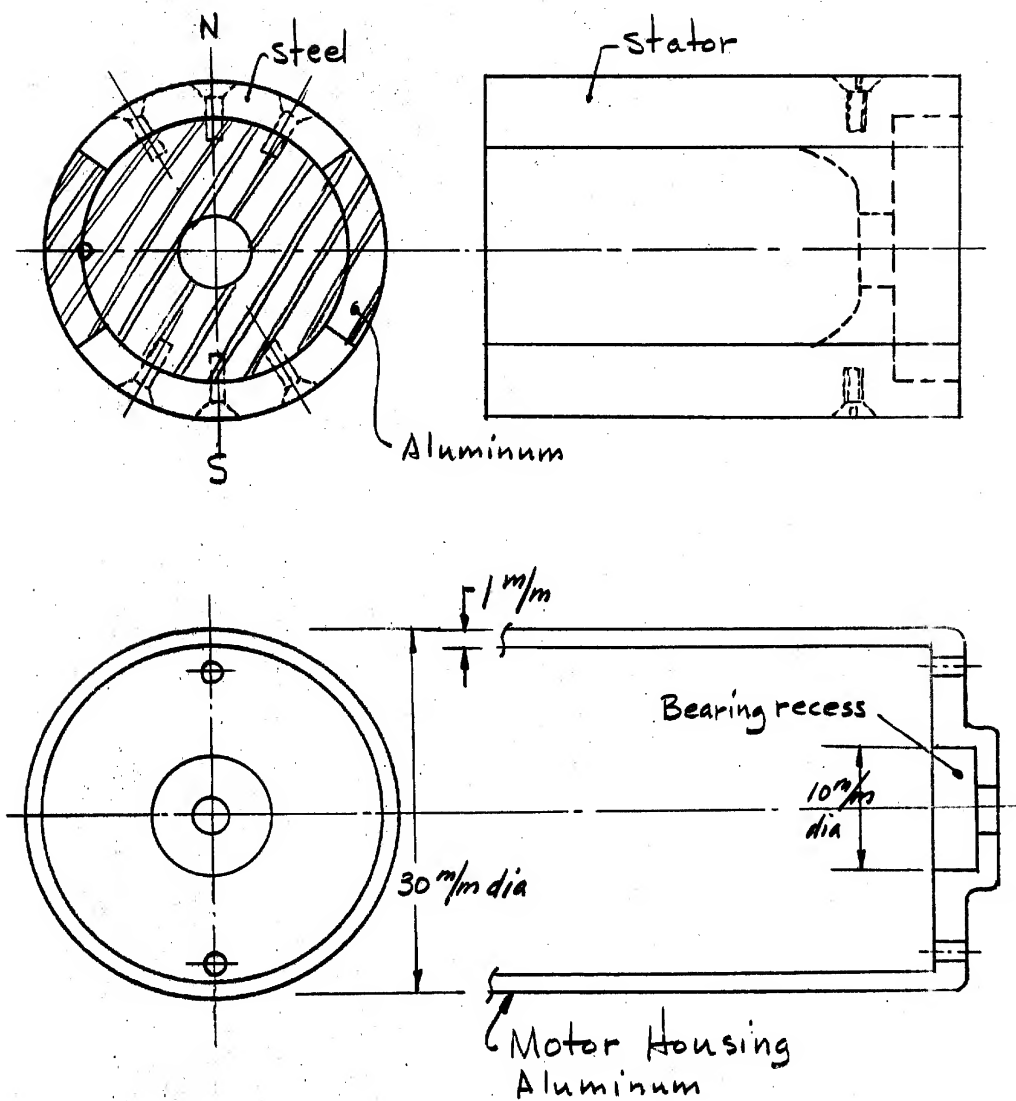


MOTOR MU OIO

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Design details M.V. 010 MOTOR

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